

California Regional Water Quality Control Board  
Santa Ana Region

March 2, 2001

Item: 12

Subject: **RESULTS OF ANNUAL WATER QUALITY SAMPLING FOR THE  
YEAR 2000 – SANTA ANA RIVER BELOW PRADO DAM**

**Summary**

The Basin Plan specifies water quality objectives applicable to Reach 3 of the Santa Ana River (River). To determine compliance with these objectives, the Basin Plan requires that sampling of the River be conducted annually at Prado Dam during base flow conditions.

Regional Board staff conducted the year 2000 sampling over a five week period during August and September. The results of the year 2000 sampling program indicate that the River at base flow is meeting Basin Plan objectives for most constituents.

Stream flow at Prado Dam during the sampling period ranged from 164 to 204 cubic feet per second (cfs).

**Background**

The Santa Ana River is the major source of recharge to the Orange County groundwater basin. The Basin Plan specifies certain water quality objectives applicable to Reach 3 of the River (Mission Blvd. in Riverside to Prado Dam) at base flow. The intent of these objectives is to protect the Santa Ana River quality and its use for groundwater recharge. Compliance with these objectives is verified by annual measurement of the base flow quality. Base flow is composed of wastewater discharges, nonpoint sources discharges (such as agricultural and urban runoff other than stormwater) and rising groundwater. Storm flow is not a component of base flow, therefore, the River is sampled at that time of year (normally August and September) when the influence of storm flow is at a minimum<sup>1</sup>.

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<sup>1</sup> In setting the base flow objectives, it was assumed that storm flows that recharge the Orange County groundwater basins would improve the quality of that groundwater. It was also recognized that there could be no assurance that such storm flows would occur each year. Therefore, it was imperative to control base flow quality such that under these worst case conditions (no high quality storm flows), Orange County groundwater quality would remain protected.

## **Methods**

The sampling program was carried out weekly from August to September 2000. Each week, an ISCO<sup>2</sup> sequential sampler was deployed to automatically collect a 24-hour composite sample. The composite sample was then sent to Associated Laboratories for mineral analyses, including total dissolved solids (TDS), chloride, sulfate, sodium, boron, hardness and electrical conductivity (EC). In addition, three grab samples were collected during each 24-hour period and analyzed for nutrients, chemical oxygen demand (COD) and total organic carbon (TOC). Associated Laboratories, the Regional Board's contract laboratory, performed all chemical analyses.

Water temperature, dissolved oxygen, pH and EC were measured in the field using a calibrated YSI<sup>2</sup> multi-parameter probe each time a grab sample was collected. Stream flow measurements were obtained from the US. Geological Survey after the sampling program was completed.

Orange County Water District (OCWD) also conducts an independent water quality monitoring program in the River and in some River tributaries in proximity to Prado Basin. OCWD collects samples in the following locations: Santa Ana River at River Road (just upstream of the Prado wetlands Santa Ana River diversion); in Mill/Cucamonga Creek and Chino Creek (tributaries entering the Santa Ana River in Prado Basin); and Prado Dam (identical location to the Regional Board's Prado Dam station (see Figure 1)). Board staff used OCWD's data to compare and confirm the Prado Dam results and also to evaluate how tributary water quality affects the results at Prado Dam.

## **Results and Discussion**

### **2000**

The year 2000 Prado Dam sample results for the mineral constituents (TDS, hardness, sodium, chloride, boron, sulfate and EC) are shown in Table 1. Five separate composite samples were collected during the base flow period. Except for sodium, all mineral parameters were below the respective Basin Plan objective.

The field data (pH, temperature, EC and dissolved oxygen) and grab sample data for total nitrogen, COD and TOC are shown in Table 2. Total nitrogen concentrations ranged from 4.5 to 11.1 mg/L, with an average concentration of 6.8 mg/L. Except for the August 31, 2000 results, all total nitrogen concentrations were below the Basin Plan objective.

COD concentrations ranged from 11 to 24 mg/L, with an average of 16 mg/L. None of the COD measurements exceeded the Basin Plan objective of 30 mg/L.

TOC is a direct measurement of the organic content in water. TOC was added to the annual sampling program in 1989 because the California Department of Health Services

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<sup>2</sup> Mention of trade names does not imply endorsement of these products.

(DHS) has proposed specific TOC concentrations when reclaimed water is used to recharge groundwater. DHS has not finalized the groundwater recharge regulations; however, the latest draft provides TOC guidelines for the Santa Ana River recharge activities. When, as in the case of the River, 46 – 50% reclaimed water is used in surface spreading for recharge purposes, the draft regulations specify a maximum allowable TOC of 6 mg/L. Once the guidelines become regulations, a TOC objective may be recommended for incorporation into the Basin Plan. The 2000 TOC concentrations in the River ranged from 4.2 to 5.5 mg/L with an average concentration of 4.78 mg/L.

OCWD sample results for dissolved oxygen, electrical conductivity, pH, water temperature, nutrients, boron, TOC and chloride are shown in Table 3. These results are consistent with the Regional Board's results from Prado Dam.

### **1983-2000**

Table 4 summarizes the yearly averages of various constituents along with their respective water quality objectives over time for the Prado Dam sampling program. The data indicate that the water quality of the Santa Ana River at Prado Dam for most of these parameters continues to improve.

The 1983 – 2000 data in Table 4 are represented graphically in Figures 2 through 10. TDS concentrations over time are shown in Figure 2. TDS concentrations continue to decrease from the elevated concentrations measured in the early 1980s.

Two of the sodium concentrations for the year 2000 were above the Basin Plan objective (see Figure 4); however, for the majority of the samples, sodium concentrations were well below the Basin Plan objective.

Figure 8 depicts total nitrogen concentrations from 1983 to 2000. In recent years, total nitrogen concentrations have been consistently below the Basin Plan objective. This may be due to a number of factors including improvements in the wastewater nitrogen discharges as the result of the Regional Board nitrogen control strategies. In addition, both OCWD and the City of Riverside operate wetland treatment facilities that serve to reduce nitrogen levels in the River and in the City's wastewater effluent.

COD concentrations over time are shown in Figure 9. The COD concentrations in 2000 were below the Basin Plan objective, unlike previous years.

### **Conclusion**

The results of the year 2000 Prado Dam sampling program indicate overall compliance with the Basin Plan objectives. Unlike previous years, COD concentrations in 2000 were below the Basin Plan objective. In two instances the sodium concentrations were above the objectives. Flow in the River was slightly lower than usual.

**TABLE 1**  
**Santa Ana River below Prado Dam**  
**Year 2000 Mineral Analyses**

Date	Discharge (cfs)	Conductivity (umhos/cm)	TDS (mg/L)	Total Hardness (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Boron (mg/L)
8/9/00	185		566	279	111*	111	106	
8/15/00	179	880	560	267	102	105	102	0.356
8/15/00	179	890	560	266	101	105	103	0.366
8/23/00	185	820	542	196	123*	108	105	0.26
8/31/00	202	880	612	279	102	100	101	0.359
9/6/00	169	812	580	228	98.5	102	103	0.343
9/14/00	169	790	514	245	96.7	117	116	0.247
<b>Average</b>	<b>181</b>	<b>845</b>	<b>562</b>	<b>251</b>	<b>105</b>	<b>107</b>	<b>105</b>	<b>0.321</b>
Basin Plan Obj.	-	-	700	350	110	140	150	0.75

\* Value equals or exceeds Basin Plan Objectives

**TABLE 2**  
**Santa Ana River below Prado Dam**  
**Year 2000 Nutrient Analyses**

Date	Time	Water Temp. (deg. C)	pH (units)	Electrical Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)	Total Nitrogen (mg/L)	COD (mg/L)	TOC (mg/L)
8/2/00	11:17	24.52	8.12	857	8.16	5.9	17	4.7
8/2/00	11:48	24.88	8.14	859	8.19	4.5	16	5.2
8/3/00	10:54	23.53	8.13	888	8.32	6.3	15	4.2
8/8/00	9:42	22.19	8.13	860	8.67	5.8	13	4.4
8/8/00	11:38	23.05	8.21	872	8.77	6.4	13	4.5
8/9/00	9:28	22.42	8.14	869	8.44	8.3	18	5
8/15/00	9:45	22.9	7.88	834	8.12	6.54	12	N/A*
8/15/00	11:15	24.02	8.17	850	8.17	6.4	9	N/A
8/22/00	9:25	22.01	8.14	890	9.8	5.7	16	N/A
8/22/00	11:51	22.96	8.21	898	10.25	5.7	18	N/A
8/23/00	12:17	23.41	8.4	896	12.31	5.7	15	4.4
8/30/00	9:15	21.49	8.19	880	9.51	7.8	11	N/A
8/30/00	9:45	21.55	8.20	882	9.47	7.7	12	N/A
8/31/00	11:40	21.77	8.27	888	9.02	11.1**	13	N/A
9/5/00	10:30	20.19	8.1	884	11.91	7.9	24	N/A
9/5/00	12:25	21.42	8.26	891	12.61	7.4	15	N/A
9/6/00	10:00	19.85	8.22	882	10.91	6	18	N/A
9/13/00	11:45	22.26	7.33	885	5.78	7.2	18	5.1
9/13/00	1:40	23.83	7.29	892	5.56	6.6	20	5.5
9/14/00	2:30	24.91	7.31	870	5.35	6.3	18	5.2
Average	-	22.66	8.04	876	8.97	6.77	15.42	4.78
<b>Basin Plan Obj.</b>		<b>-</b>	<b>6.5-8.5</b>	<b>-</b>	<b>5.0</b>	<b>10</b>	<b>30</b>	<b>-</b>

\* N/A = not analyzed

\*\* Value equals or exceeds Basin Plan Objective

**Table 3 – Orange County Water District's Year 2000 Monitoring Results**

Date	Station Name	Dissolved Oxygen (mg/L)	EC (umho/cm)	pH (units)	Temp. (deg C)	Ammonia Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Nitrite Nitrogen (mg/L)	Boron (mg/L)	TOC@ (mg/L)	Chloride (mg/L)
8/1/00	CK-Chino - 03	7.1	872	7.6	25.0	<.1	4.42	0.064	0.33	6.41	106
8/8/00	CK-Chino - 03	7.3	820	7.6	24.3	<.1	4.32	0.045	0.36	5.89	103
8/15/00	CK-Chino - 03	6.7	850	7.9	25.2	<.1	3.58	0.06	0.33	6.91	103
8/22/00	CK-Chino - 03	8.09	918	8.4	26.2	<.1	3.7	0.06	0.29	6.75	95
8/29/00	CK-Chino - 03	6.69	884	7.5	24.4	0.3	4.95	0.073	0.38	28.1	100
8/1/00	CK-Mill - 01	14.8	690	9.5	30.3	0.2	3.25	0.081	0.33	8.17	94.5
8/8/00	CK-Mill - 01	10.9	690	9.2	24.4	0.2	3.25	0.191	0.31	7.76	87.4
8/15/00	CK-Mill - 01	12.9	660	9.6	23.8	0.2	2.49	0.146	0.31	8.76	86.5
8/22/00	CK-Mill - 01	8.87	702	9.9	30.9	0.1	4.15	0.118	0.32	8.24	83.4
8/29/00	CK-Mill - 01	11.9	687	9.6	25.6	<.1	5.65	0.135	0.39	8.39	88.4
8/1/00	CK-Temescal - 02	N/A	N/A	N/A	N/A	<.1	6.72	0.275	0.25	3.83	90.8
8/8/00	CK-Temescal - 02	8.0	880	8.5	19.8	<.1	7.44	0.235	0.25	3.77	87
8/15/00	CK-Temescal - 02	8.60	945	8.3	23.1	<.1	7.43	0.196	0.24	4.1	90
8/22/00	CK-Temescal - 02	9.79	836	9.2	27.7	<.1	7.2	<.002	0.23	5.13	86.6
8/1/00	SAR-belowdam-01	7.35	960	7.8	23.6	0.1	5.18	0.077	0.35	4.55	109

\*value equals or exceeds Basin Plan Objective

NA – not analyzed

@- value is for unfiltered sample

**Table 3 – Orange County Water District's Year 2000 Monitoring Results - Continued**

Date	Station Name	Dissolved Oxygen (mg/L)	EC (umho/cm)	pH (units)	Temp. (deg C)	Ammonia Nitrogen (mg/L)	Nitrate Nitrogen (mg/L)	Nitrite Nitrogen (mg/L)	Boron (mg/L)	TOC@ (mg/L)	Chloride (mg/L)
8/8/00	SAR-belowdam-01	7.35	960	8.1	22.1	<.1	5.05	0.099	0.35	4.43	88
8/15/00	SAR-belowdam-01	7.9	960	7.9	23.3	<.1	5.23	0.095	0.35	4.57	94
8/21/00	SAR-belowdam-01	8.02	981	8.0	23.5	<.1	5.4	0.058	0.33	4.45	98.5
8/29/00	SAR-belowdam-01	9.2	975	7.9	22.5	<.1	5.49	0.069	0.43	4.83	99
8/1/00	SW-RP2MillCRK-02	7.6	757	7.8	27.2	0.2	5.42	0.063	0.33	5.27	105
8/8/00	SW-RP2MillCRK-02	8.0	760	7.8	27.3	<.1	4.39	0.044	0.33	6.89	93
8/15/00	SW-RP2MillCRK-02	8.4	760	8.3	27.4	<.1	4.66	0.041	0.32	5.56	94.8
8/22/00	SW-RP2MillCRK-02	9.52	757	9.2	28.8	<.1	5.11	0.05	0.31	6.12	95.4
8/29/00	SW-RP2MillCRK-02	8.37	767	8.5	26.2	<.1	6.28	0.059	0.41	6.08	94.1
8/1/00	SAR-RIVRRD-01	N/A	N/A	N/A	N/A	<.1	8.25	0.014	0.18	2.71	104
8/8/00	SAR-RIVRRD-01	8.8	970	8.5	22.4	<.1	8.10	0.013	0.18	2.87	98
8/15/00	SAR-RIVRRD-01	7.55	1030	8.3	25.7	<.1	11.3	0.061	0.17	3.03	99.8
8/22/00	SAR-RIVRRD-01	7.12	1010	9.1	30.1	<.1	7.99	0.015	0.16	7.18	86.5
8/29/00	SAR-RIVRRD-01	7.63	991	8.1	22.3	<.1	7.81	0.012	0.18	3.4	93.7

\*value equals or exceeds Basin Plan Objective

NA – not analyzed

@- value is for unfiltered sample

**TABLE 4**  
**Santa Ana River Base Flow Results for 1983 – 2000**

Date	Discharge (cfs)	TDS (mg/L)	Total Hardness (mg/L)	Sodium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Boron (mg/L)	Total Nitrogen (mg/L)	COD (mg/L)	TOC @ (mg/L)
1983	213	716*	356*	91	85	NA	0.30	8.2	86*	NA
1984	128	683	350*	96	116	159*	0.40	7.3	58*	NA
1985	138	682	339	96	115	150*	0.33	9.8	33*	NA
1986	123	656	290	98	110	127	0.25	10.2*	43*	NA
1987	132	641	323	97	97	134	0.45	10.2*	27	NA
1988	134	629	297	102	111	130	0.25	10.3*	38*	NA
1989	127	635	290	102	115	128	0.30	10.2*	31*	9.9
1990	131	640	289	107	117	128	0.36	11.9*	26	9
1991	124	648	281	89	101	114	0.36	10.9*	18	5.3
1992	136	617	282	98	110	108	0.36	10.6*	18	4.9
1993	130	672	288	99	125	128	NA	8.2	30*	NA
1994	119	629	286	101	114	140	0.38	8.6	40*	5.5
1995	141	636	276	91	103	104	0.28	7.5	27	4.8
1996	168	578	250	88	97	106	0.27	9.5	22	5.4
1997	149+	607+	218+	89+	99+	112+	0.36+	6.3+	NA	9.7+
1998	245	524	264	85	96	100	0.30	7.4	30@	4.7
1999	190	586	271	99.5	101	110	0.341	6.3	30*	4.8
2000	186	562	251	105	107	105	0.321	6.765	15.47	4.78
<b>Basin Plan Objective</b>		<b>700</b>	<b>350</b>	<b>110</b>	<b>140</b>	<b>150</b>	<b>0.75</b>	<b>10</b>	<b>30</b>	<b>-</b>

\* Value equals or exceeds Basin Plan Objective

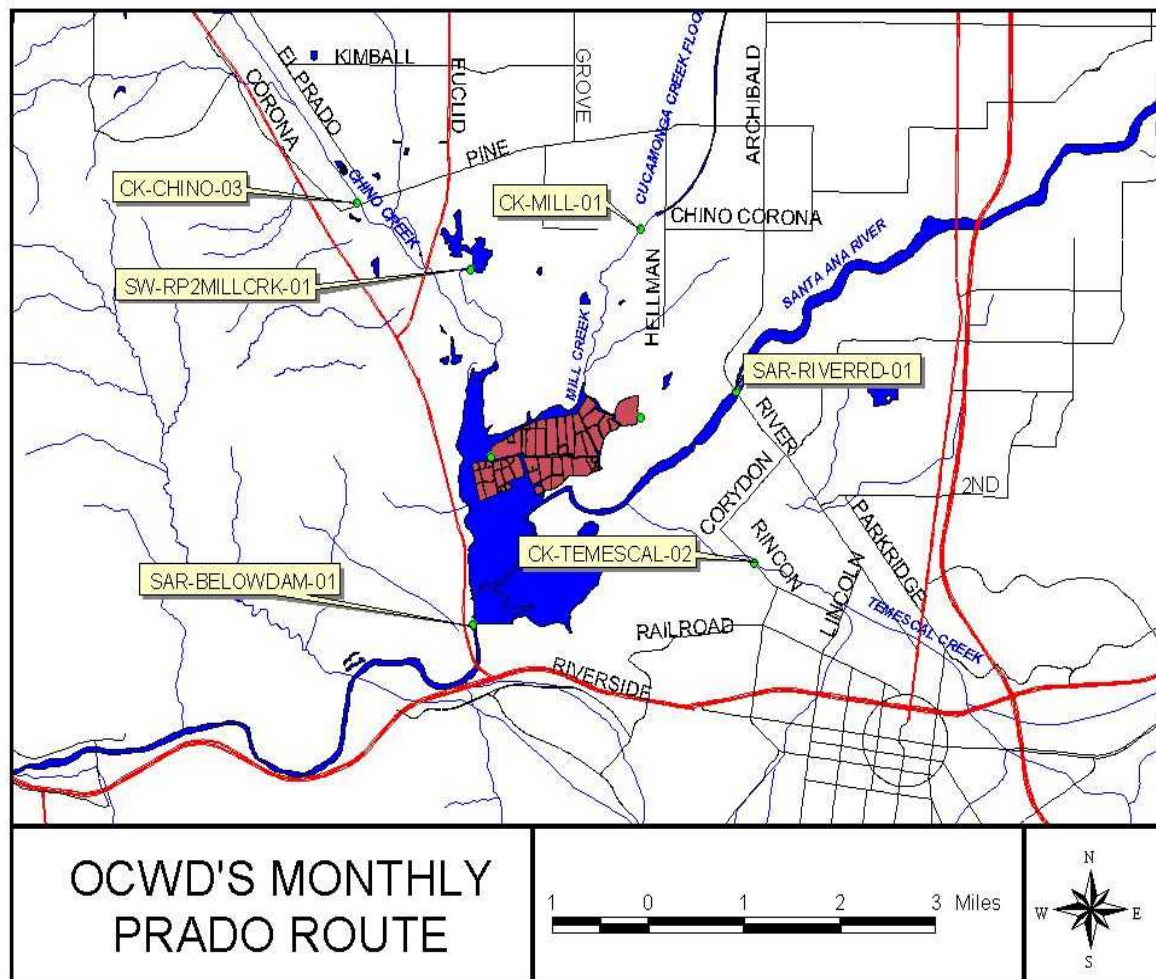
N/A Not analyzed

+ 1997 Calculated results

@ value is for unfiltered sample



### Figure 1 – Orange County Water District’s Sampling Sites



**Figure 2 - Total Dissolved Solids concentrations over time**

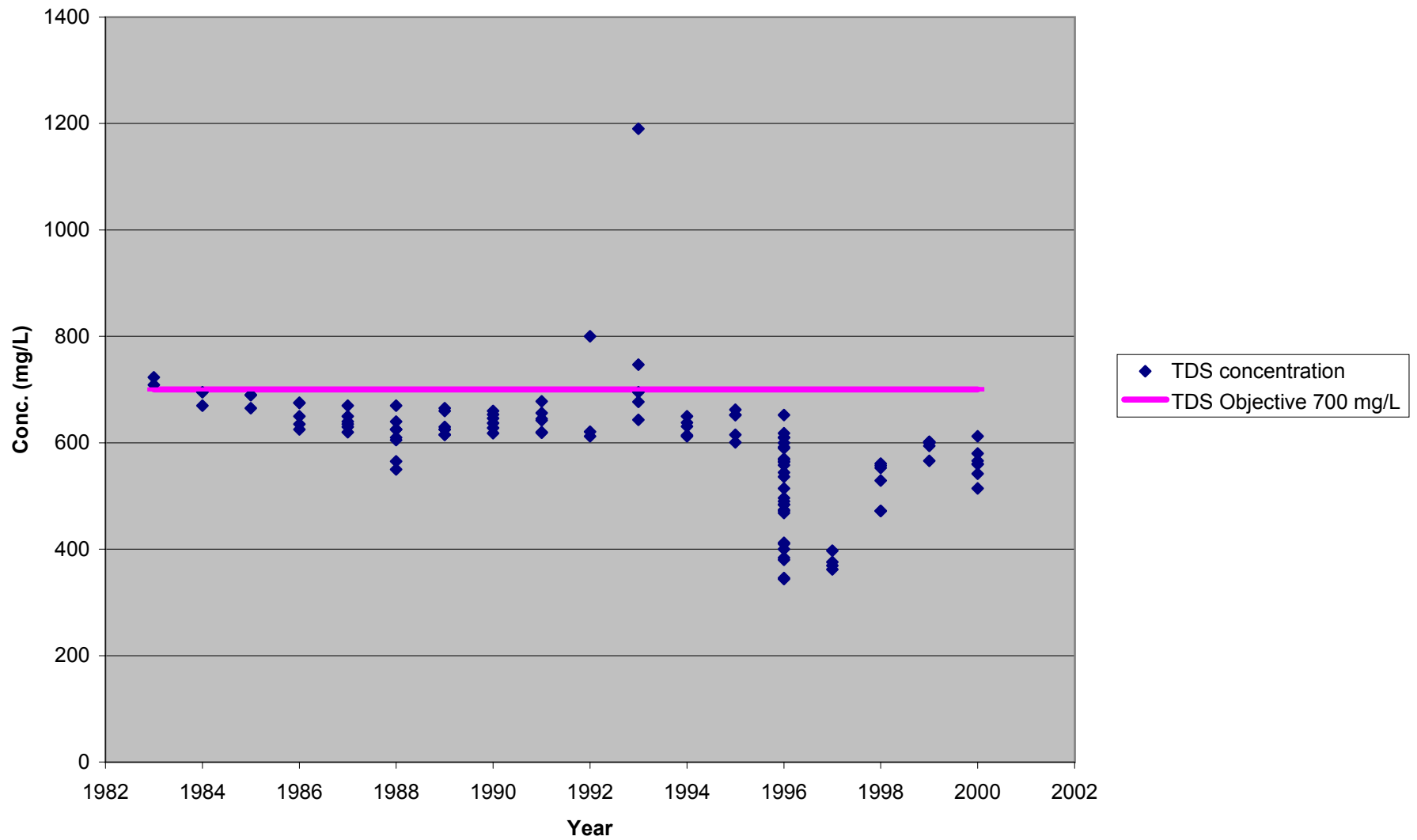


Figure 3 - Total Hardness concentrations over time

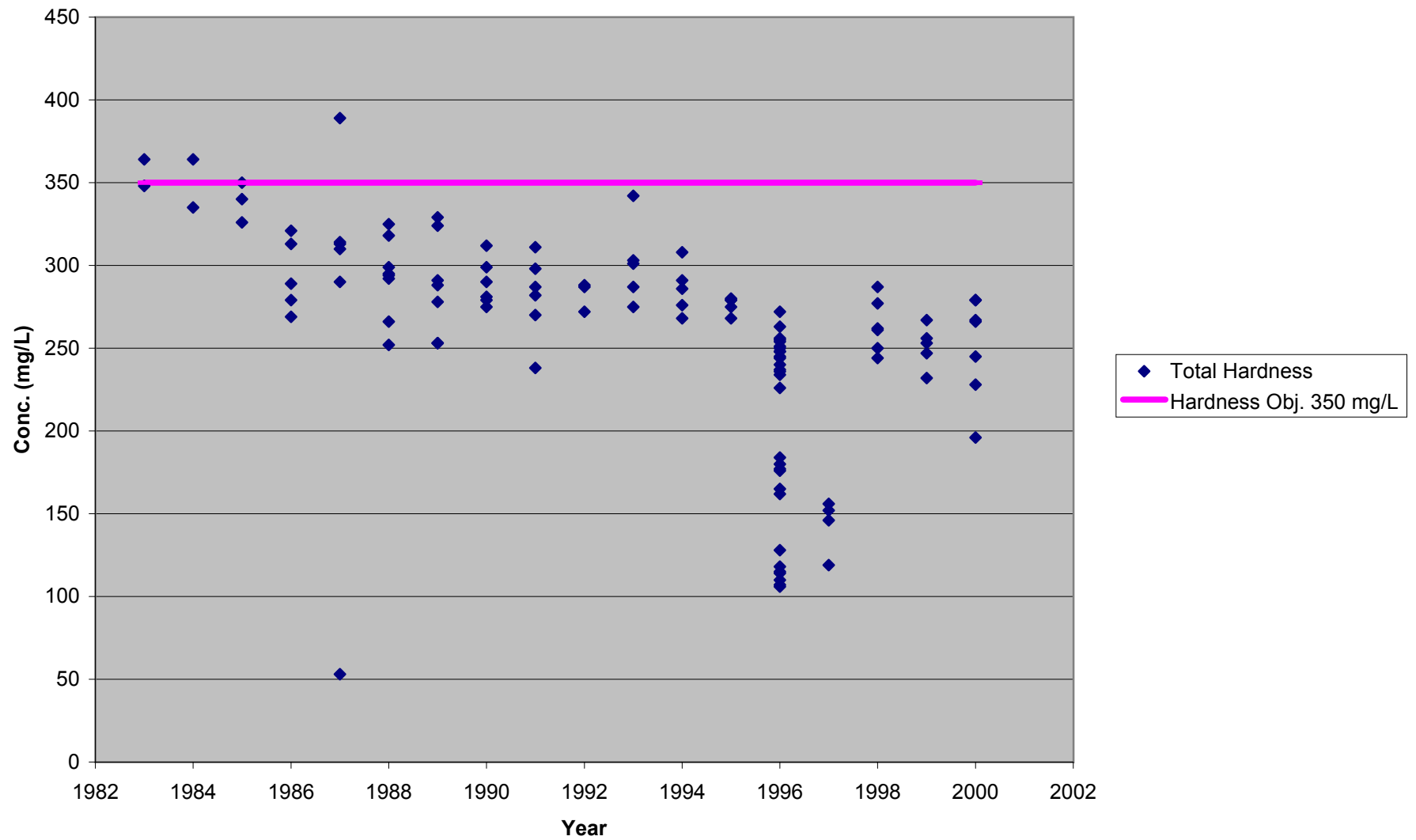


Figure 4 - Sodium concentrations over time

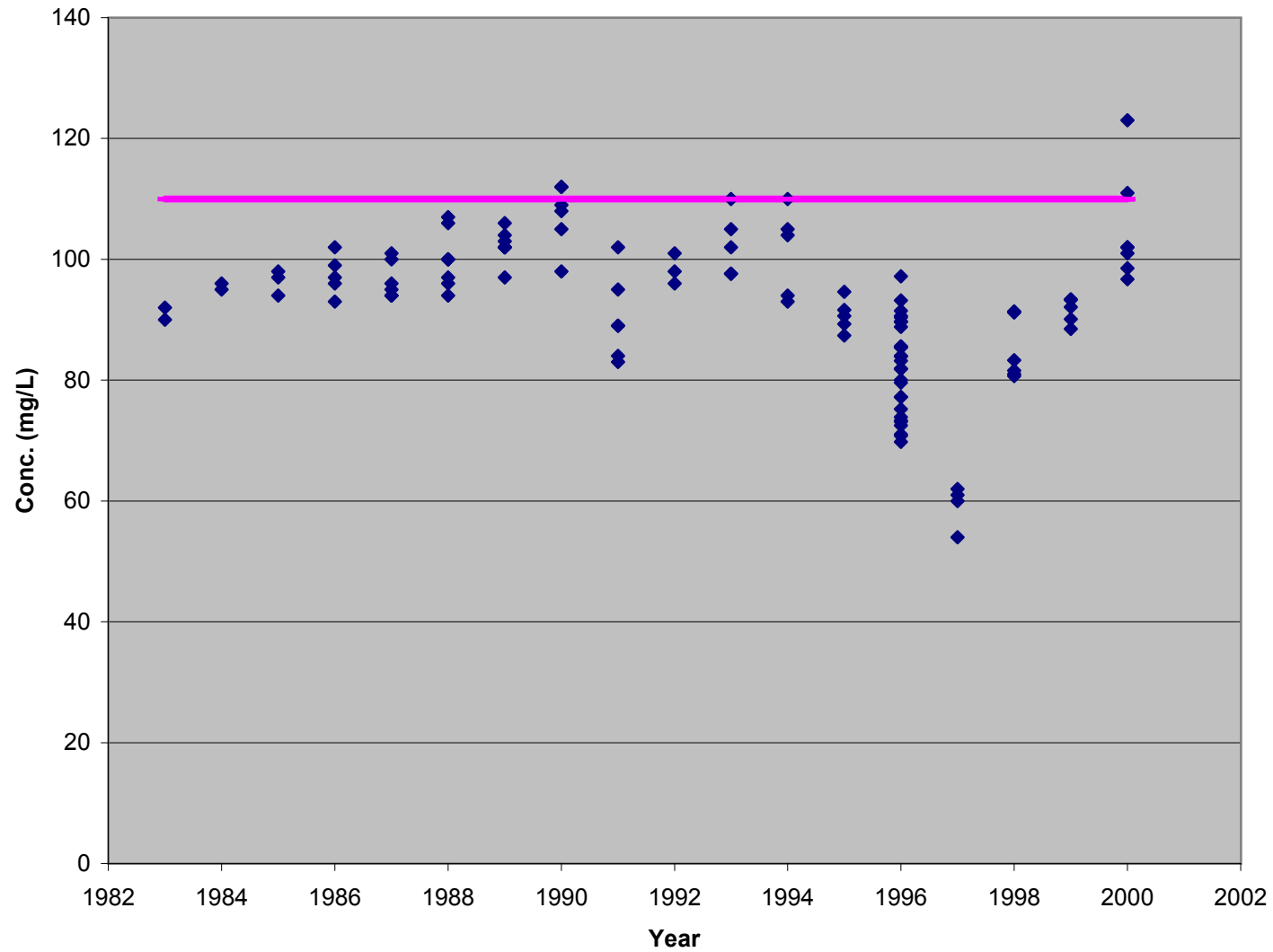


Figure 5 - Chloride concentrations over time

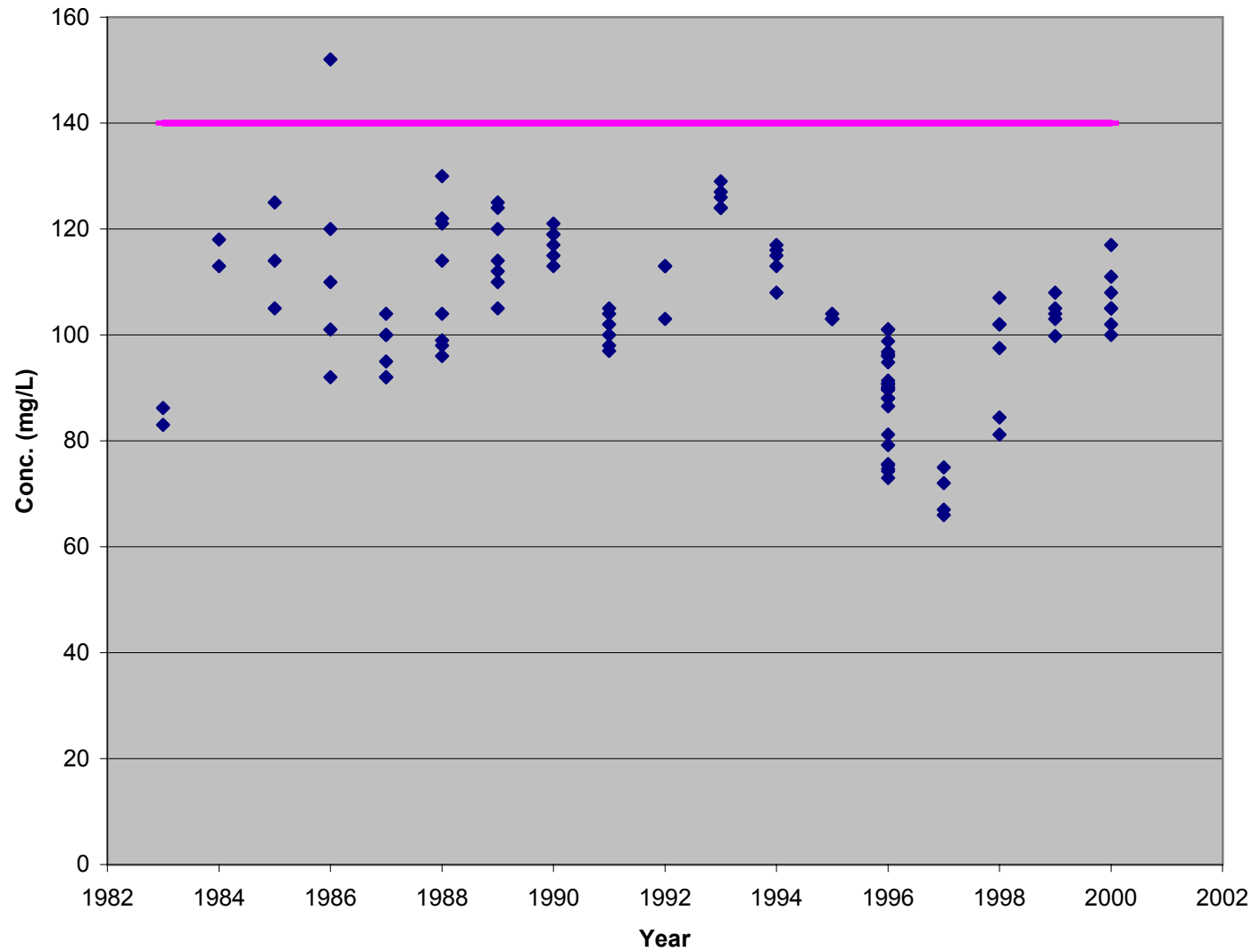


Figure 6 - Sulfate concentrations over time

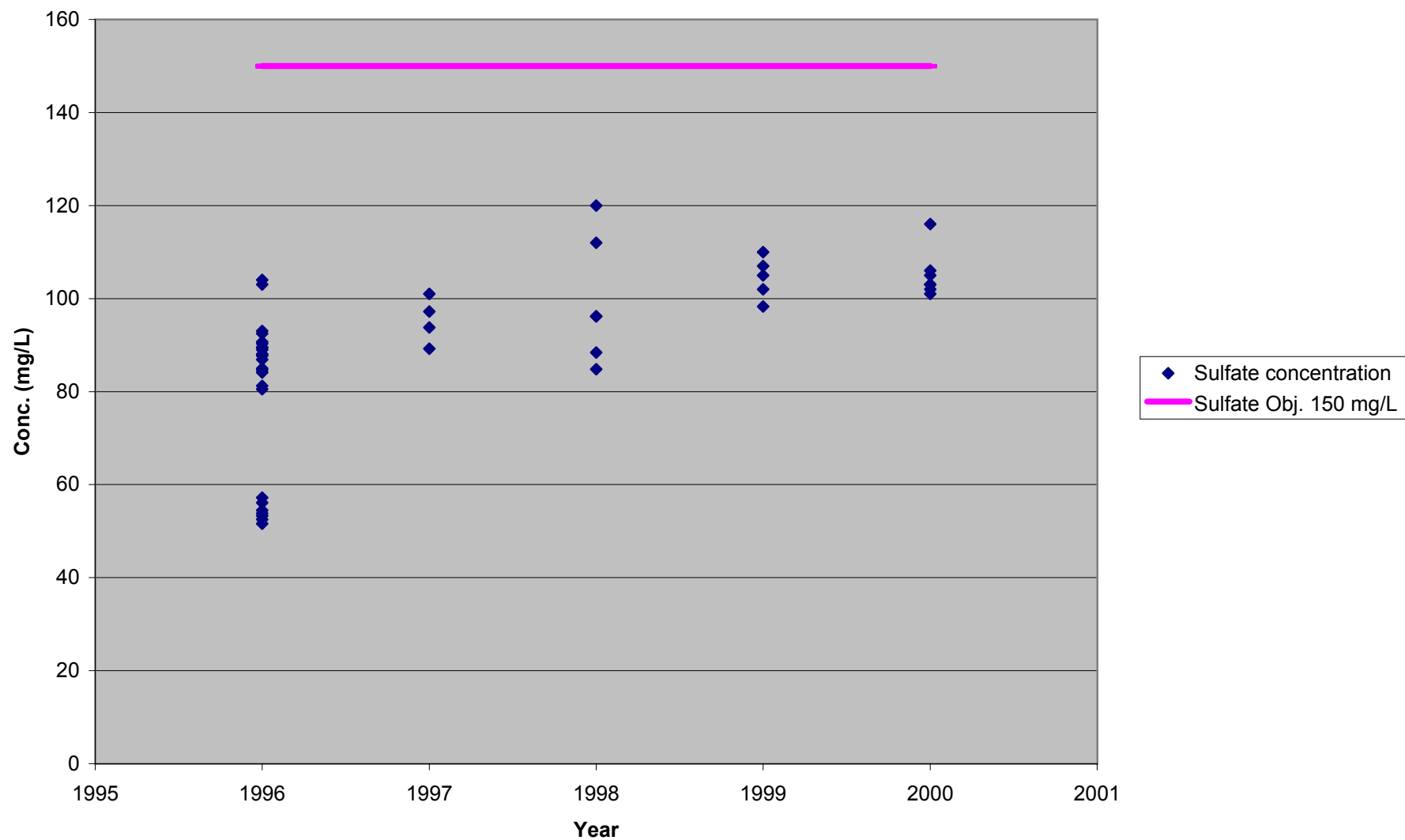


Figure 7 - Boron concentrations over time

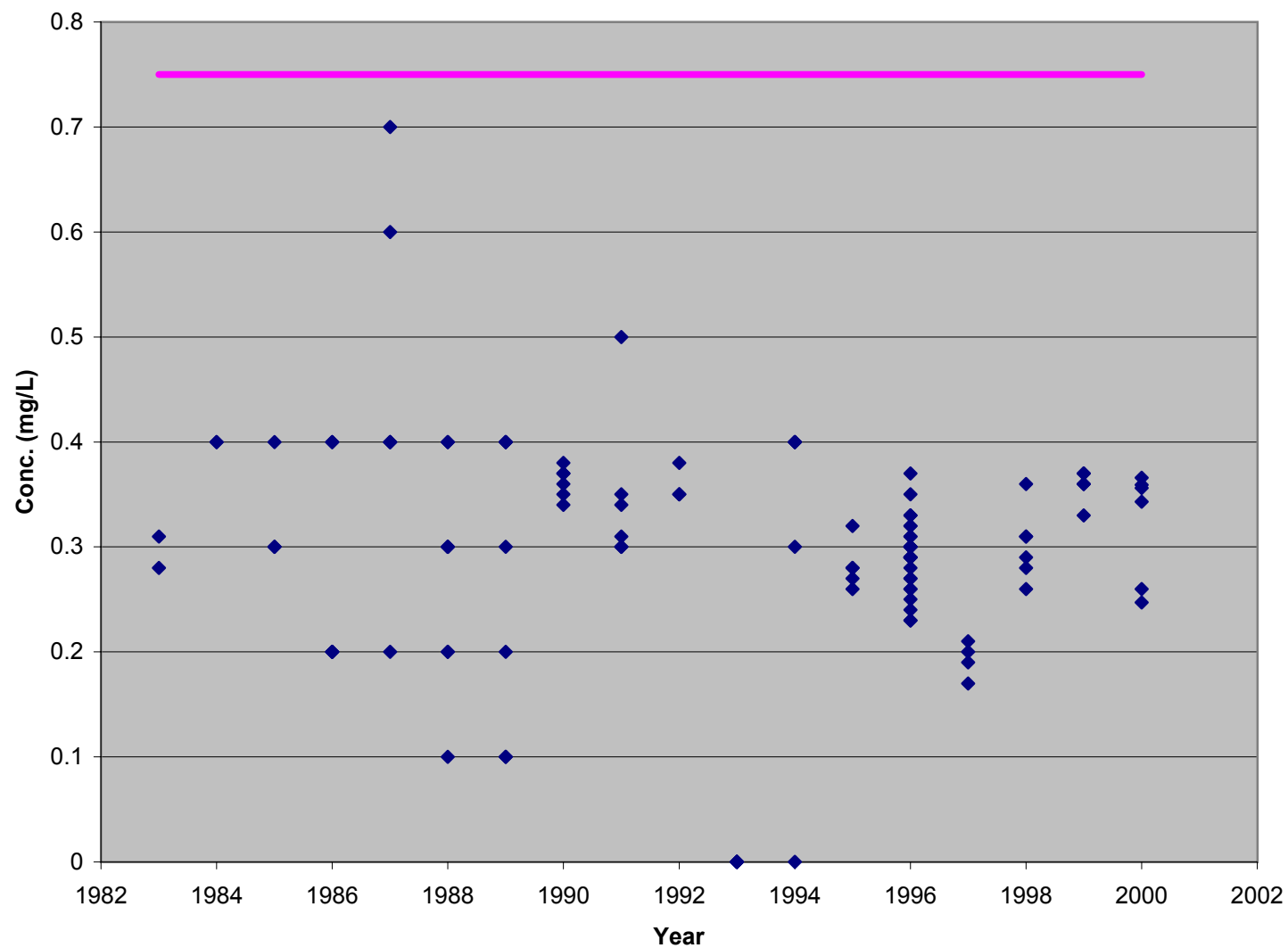


Figure 8 - Total Nitrogen concentrations over time

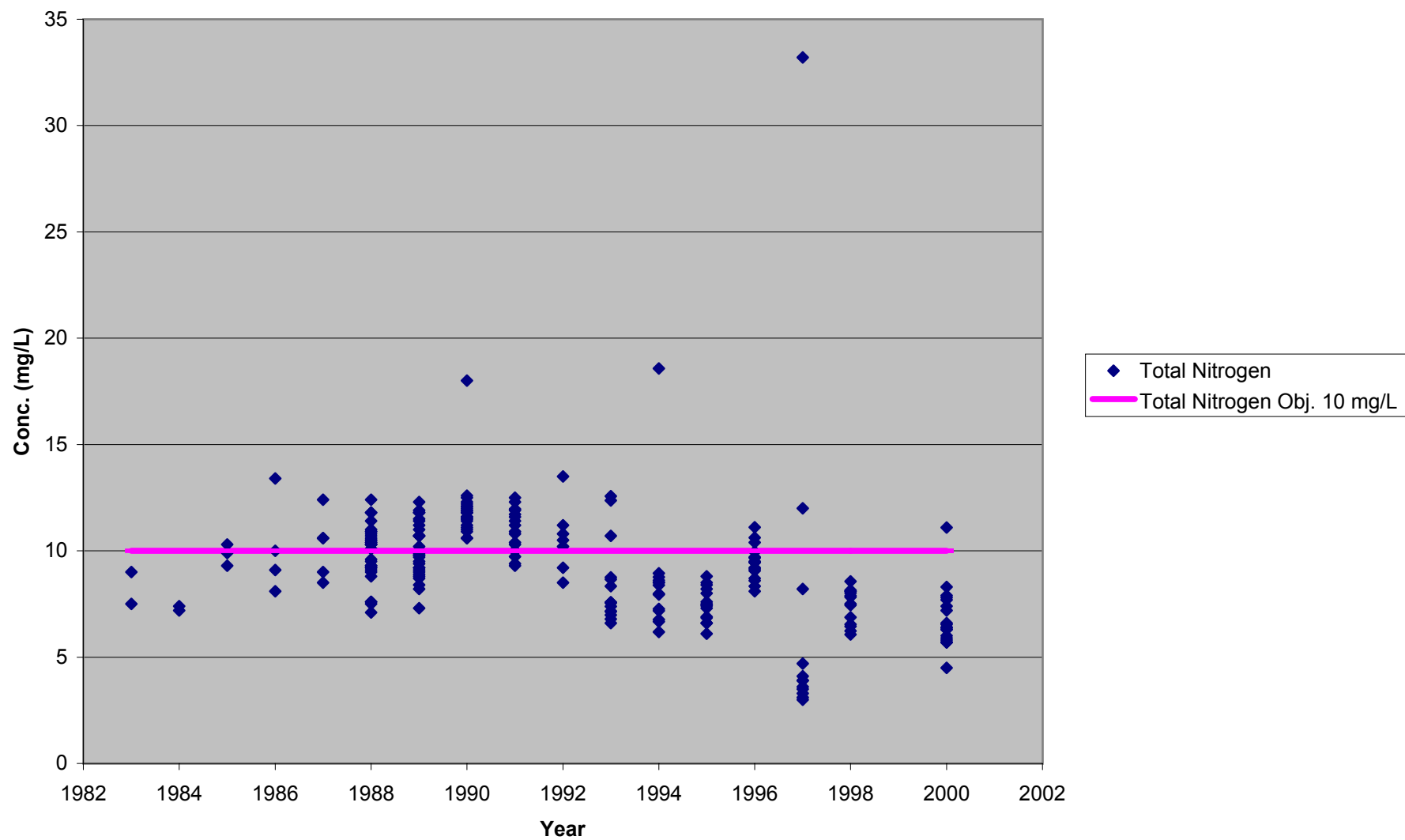




Figure 9 - Chemical Oxygen Demand concentrations over time

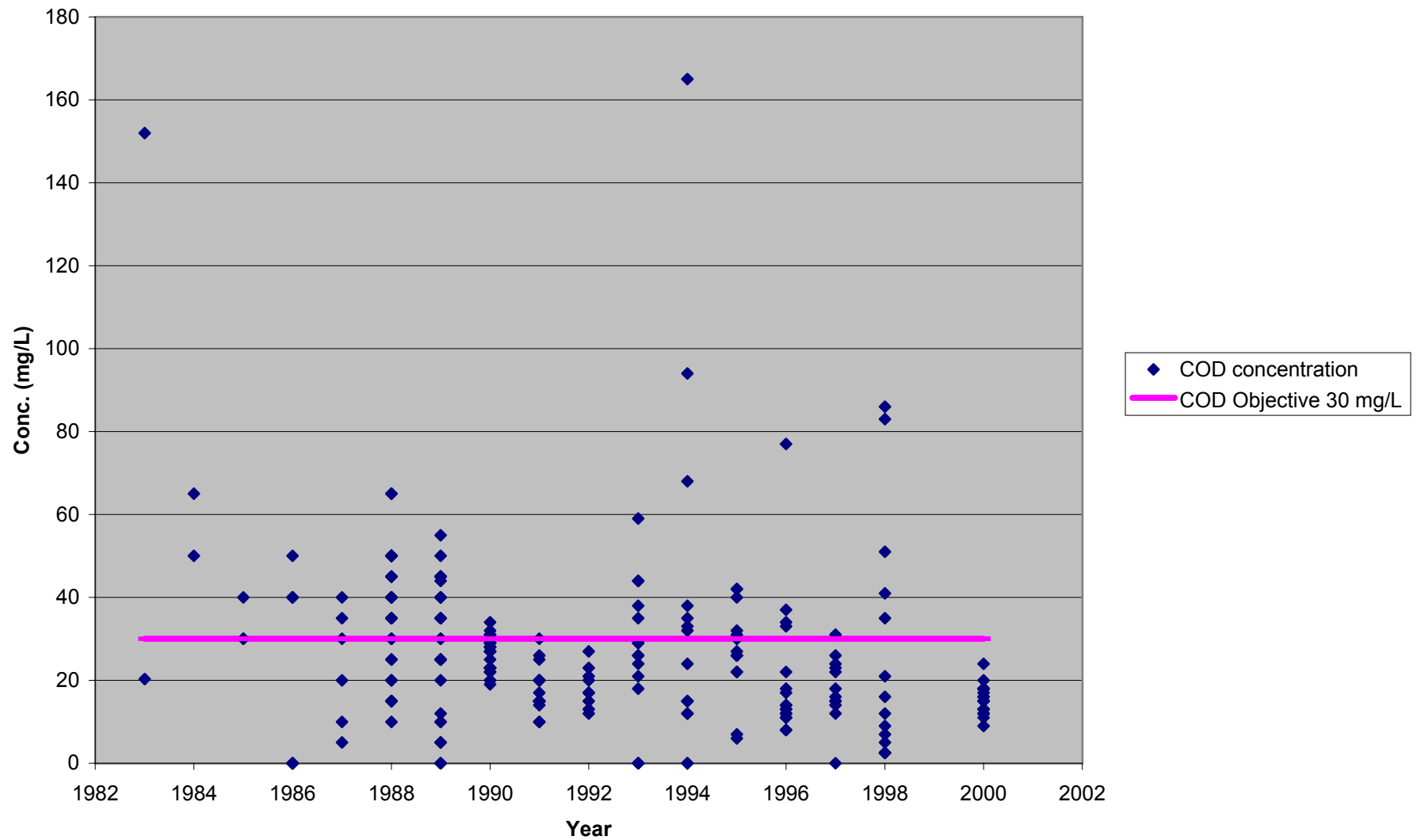


Figure 10 - Total Organic Carbon concentrations over time

